

REMARKS

Reconsideration of the above-identified application in view of the present amendment is respectfully requested. By the present amendment, the specification at page 3, line 5 has been amended to correct a typographical error that was made in the previous amendment. Claim 20 has been amended so that the term "comprising" has been replaced with the term "consisting essentially of" and the term "linear energetic polymer" has been replaced with the term "hydroxyl terminated glycidyl azide polymer". Support the limitations "hydroxyl terminated" and "glycidyl azide polymer" can be found on page 11 of the present application. Page 11 shows a hydroxyl terminated glycidyl azide polymer. Claims 35 and 36 have been amended so that the term "hydroxyl terminated" is added before the term "glycidyl azide polymer" in the claims. Claims 21, 23, 32, and 33 have been cancelled. Claim 24 has been amended to correct the dependency of claim 24.

Below is a discussion of the Office Action's 35 U.S.C. §112 first paragraph rejection, 35 U.S.C. §112 second paragraph rejection, and 35 U.S.C. §103 rejections.

I. 35 U.S.C. §112, first paragraph, rejections.

Claims 20-30, 32-33, 35, and 36 were rejected under 35 U.S.C. §112, first paragraph, as containing subject matter, which was not described in the specification in such a way as to reasonably convey to one skilled in the art that the inventor, at the time the application was filed, had possession of the claimed invention.

Claims 21, 23, 32 and 33 were cancelled. Claims 20, 22, 24-30, 35 and 36 are described in the specification in such a way as to reasonably convey to one skilled in the art that the inventor, at the time the application was filed, had possession of the claimed invention.

A patent application is required to contain a written description of the invention only with respect to the claimed subject matter. Accordingly, the written description requirement does not apply to features of an invention that are not included in the claim section of the patent application. In re Moore, 169 USPQ 236, 238-239 (C.C.P.A. 1971).

Claim 20, which is the broadest of the claims, recites that the gas generating material includes:

"a thermoplastic elastomer consisting essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and optionally 2,4 pentanediol, wherein the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, 2,4-pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1."

The present patent application contains a written description of the subject matter of claim 20. Page 10 and page 11 of the specification show that in a preferred embodiment of the invention 4,4-methylene bis-phenylisocyanate is reacted with GAP-1000 to form GAP-M. GAP-1000, as shown on page 11, is a hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two. 4,4-methylene bis-

phenylisocyanate is an aromatic diisocyanate. GAP-M, as shown on page 11, is a polyurethane. As stated on page 9, lines 14+, if the amount of aromatic diisocyanate and GAP are controlled so that the ratio of isocyanate groups to hydroxyl groups is about 1, a thermoplastic polyurethane elastomer will form.

Thus, the subject matter of claim 20 is described in the specification in such a way to one of ordinary skill in the art that Applicant had possession of the claimed invention at the time the application was filed. Therefore, withdrawal of the 35 U.S.C. §112 rejection is respectfully requested.

With respect to the arguments presented in the Office Action that the claims of the application were not described in the specification in such a way as to reasonably convey to one skilled in the art that the inventor, at the time the application was filed, had possession of the claimed invention, the Applicant fails to see the arguments' relevance to this rejection.

First, the Office Action states that the change to delete the term "block" is per se okay, but that it has not been carried out uniformly throughout; therefore, the specification not only remains incorrect but inconsistent throughout (Item 3; paragraph 2).

The term "block" has been deleted from the application in the previous two amendments. The Applicant, therefore, requests that the Office Action particularly point out where the term "block" remains in the application or that the Office Action withdraw this rejection.

The Office Action also states that the basis for the added amounts as in claim 35, newly recited ingredients as in claim 21, and so on, has not been pointed out and that the Applicant is required to point out the basis for such newly claimed terms, or to cancel them.

The basis for the amounts in claims 21 and 35 was presented in the amendment dated February 1, 2002. As stated in the previous amendment, the ingredients listed in claim 21 can be found in the specification on page 8, lines 6 and 7, which state that the preferred linear energetic polymer is glycidyl azide polymer and page 9, lines 3-13, which lists other linear energetic polymers that can be used in the present invention.

The amounts listed in claim 35 can be found in the specification on page 6, lines 23-24, which states that the preferred amount of inorganic salt oxidizer is in the range of about 65% to about 90% by weight based on the weight of the gas generating material, and page 13, lines 22-24, which states that a preferred weight % of thermoplastic elastomer is from about 5% to about 35% based on the weight of the gas generating material.

Next, the Office Action asserts that the nature of the polymer in the invention is critical or essential to the practice of the invention, but it is neither claimed nor enabled by the disclosure. The Office Action notes, at the last paragraph on page 2 and continuing to page 3, various references, which utilize the term "block". The first

paragraph on page 3 then concludes that this is not what the Applicant is doing.

As noted above, the term block has been deleted from the specification as well as from the claims. Therefore, an argument about the how the term "block" is used is no longer relevant. Accordingly, the Applicant requests that Office Action please point out the relevance of these statements.

In the second paragraph of page 3, the Office Action further states,

"Indeed, the further definitions for polymer and polyurethane, for example, show that the Applicant has misused language throughout the application regarding polymer details."

The Office Action, however, provides no specific examples of how these definitions are misused in the application. Moreover, the reaction of GAP-1000 and 4,4'-methylene bis-phenylisocyanate clearly forms a polyurethane and glycidyl azide polymer is clearly a polymer. Accordingly, the Applicant requests that the Office Action provide some basis for this assertion or withdrawal this rejection.

The Office Action further states that,

"to recite a secondary alcohol with only one example in a chemical case, is to deprive the person of ordinary skill in the art of what is required to be effective...[and that] Applicants changes to the claims to eliminate the term secondary alcohol therefrom are noted, but this does not affect that the specification informs the meanings of the claim terms."

The Applicant agrees with the Office Action that the specification forms the meaning of the claim terms, but fail

to see the relevance of this argument as the claims no longer recite the term secondary alcohol and that structure of 2,4-pentanediol is well known.

The Office Action then states that throughout the specification and claims, incorrect language or terminology is used to such an extent that the ordinary artisan is not taught what the invention is, or how to practice it.

As noted above, the claimed invention, a part of which relates to a thermoplastic elastomer that comprises a polyurethane formed from glycidyl azide polymer and an aromatic diisocyanate is clearly taught on a pages 10 and 11.

The Office Action also states that the idea of physical cross-linking is not correctly conveyed to one of ordinary skill in the art, that it is not clear what the difference between what Applicant does and what Hawley's teaches occurs for all polyurethane elastomers, and that this basis is not sufficient for perverting ordinary art understood language.

The Applicants again fail to see the relevance of this argument. The idea of physically cross-linking is not claimed. Since this feature is not claimed, any written description with respect to this term is not relevant for rejection of claims under 35 U.S.C. §112, first paragraph.

Finally, the Office Action states that claim 20 as amended has been expanded to include encompass any polyurethane, which also lacks proper disclosure basis.

Claim 20 was not expanded to encompass all polyurethanes. Claim 20 is limited to polyurethanes formed from glycidyl azide polymers with a hydroxyl functionality of two or less

and aromatic diisocyanates. Regardless, the Applicant fails to see how this argument in the Office Action bares any relevance to the 35 U.S.C. §112, first paragraph rejection.

II. 35 U.S.C. §112, second paragraph, rejections

Claims 20-37 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter, which Applicant regards as the invention.

The Office Action states that the language in the claims is incorrect, cannot be understood by the person of ordinary skill in the art, and fails to set forth the metes and bounds of the claimed invention.

First, the Office Action states it is not clear what is required by the "thermoplastic elastomer" language; particularly since the language does not specify any particular "linear energetic polymer", but merely recites what would be required for an ordinary polyurethane polymer.

The Applicant respectfully disagrees with the Office Action that the "thermoplastic elastomer" language is indefinite.

The "thermoplastic elastomer" language is not indefinite because the term is used consistently with prior art teachings and the term is clear to a person of ordinary skill in the art. The Textbook of Polymer Science states on page 379, second paragraph (See copy attached with February 1, 2002 amendment), that:

"The term *thermoplastic elastomers* is currently used to describe a wide variety of materials that have elastomeric

properties at ambient temperatures, but process like thermoplastics, obviating the need for the vulcanization step to develop typical rubber like elasticity.

The thermoplastic elastomer of the present invention is consistent with this definition.

Second, the Office Action states that the claim language of "aromatic diisocyanate" and "a linear energetic polymer" at best only forms a polyurethane to one of ordinary skill in the art.

Claim 20 has been amended so the term "linear energetic polymer" has been amended so that it now recites "hydroxyl terminated glycidyl azide polymer".

Additionally, the Applicant respectfully disagrees that the claim language "aromatic diisocyanate" and "linear energetic polymer" (now amended to "hydroxyl terminated glycidyl azide polymer") at best only forms a polyurethane. The definiteness of the language employed in the claim must be analyzed not in a vacuum, but in light of the particular application disclosure and the prior art teachings as it would be interpreted by one of ordinary skill in the art. In re Angstadt, 537 F.2d 498, 190 USPQ 214, 217, (C.C.P.A. 1976). One of ordinary skill in the art reading the specification would realize that an aromatic diisocyanate and a "hydroxyl terminated glycidyl azide polymer" can be used to form a thermoplastic elastomer. Moreover, both Thermoplastic Elastomers and Encyclopedia of Chemical Technology (copies of both articles which were attached in the previous Office Action) teach that thermoplastic elastomers can be formed from

polyurethanes, which are made using aromatic diisocyanates and a polymer. Thus, the specification and the prior art teachings do not suggest that the "aromatic diisocyanate" and the "hydroxyl terminated glycidyl azide polymer" "at best" only form a polyurethane.

Moreover, it is not the normal function of the claims to disclose the invention but to point out the features of novelty in the invention as disclosed in the specification. Bocciarelli v. Hoffman, 109 USPQ 385, 388 (C.C.P.A. 1956).

Claim 20 does not attempt to disclose the invention, but instead point out the novel features of the invention. Thus, one looking at claim 20, without considering the specification and the prior art teachings, may arrive at the conclusion that "at best only a polyurethane would be formed", but this conclusion would be improper because the claims must be viewed in light of the specification and the prior art teachings.

Additionally, the Office Action states that the terms "segment" and "elastomer" as used lack proper factual basis.

The Applicant respectfully disagrees that the terms "segment" and "elastomer" lack proper factual basis. The use of both these terms in relation to thermoplastic polyurethane elastomers is well known in the art as shown on pages 16-22 of Thermoplastic Elastomers and pages 20-24 of Encyclopedia of Chemical Technology (see copies of articles in February 1, 2002 amendment) . Moreover, these terms are supported by the specification. Thus, the terms "elastomer" and "segment" have a factual basis.

Moreover, the Applicant fails to see where in the present claims the term "segment" is even mentioned. The Applicant, once again (See February 1, 2002 amendment), requests that the Office Action please specify where the term "segment" is used in the claims.

Finally, the Office Action states that the amount of the segment of the polymer does not make sense.

The Applicant fails to see where in present claims the amount of a segment is mentioned or where the term segment in the claims is used at all. The Applicant, once again (See February 1, 2002 amendment), requests that the Office Action please specify where the term "segment" is used in the claims and where the language "amount of segment" is used in the claims.

III. 35 U.S.C. §103(a), rejections

A. Obviousness rejection in view of Zeigler, Manzara et al., Manser, and Gomez et al.

Claims 20-30, 32-33, 35 and 36 were rejected under 35 U.S.C. §103(a) as being unpatentable over Re. 36,296 to Zeigler in view of U.S. Patent No. 5,164,521 to Manzara et al., U.S. Patent No. 4,393,199 to Manser, and U.S. Patent No. 5,319,037 to Gomez. Claims 21, 23, 32, and 33 were cancelled.

Claim 20 is patentable over Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. because Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and

optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

As noted in the Office Action Zeigler teaches the basic idea of an air bag system with a gas generating composition that comprises an oxidizer of ammonium nitrate, a fuel (e.g., HMX or RDX), and an energetic GAP binder. Zeigler further states that:

"These materials are normally liquid materials and need to be formulated with an appropriate amount of a suitable curative to crosslink the material, e.g., from about 10-15% by weight based on the weight of binder of a multifunctional isocyanate such as hexamethylene diisocyanate and/or 4,4'-diisocyanatodicyclohexyl-methane."
(Column 4, lines 7-12).

Zeigler does not teach or suggest that the cross-linked glycidyl azide polymer forms a thermoplastic elastomer. Zeigler teaches that a suitable curative is used to cross-link the glycidyl azide polymer. In fact, a binder, which is cured by cross-linking, is generally not considered to be thermoplastic. To support the assertion that a binder, which is cured by cross-linking, is generally not considered to be a thermoplastic, the Applicant first refers to Whittington's Dictionary of Plastics (see copy of attachment to February 1, 2002 amendment. Whittington's Dictionary of Plastics at page 59 and 60 defines the term "cured" as,

"To change the properties of a plastic or resin by chemical reaction, which for

example may be condensation, polymerization, or addition; usually accomplished by the action of either heat or catalyst or both, and with or without pressure. The term cure is used almost exclusively in connection with thermosetting plastics, vulcanizable elastomers and rubbers."

Additionally, Hawley's Condensed Chemical Dictionary (see copy attached to February 1, 2002 amendment) on page 325 defines cross-linking as the,

"Attachment of two chains of polymer molecules by bridges, composed of either, an element, a group, or a compound, which join certain carbon atoms of the chains by primary chemical bonds."

Hawley's Condensed Chemical Dictionary further notes that,

"cross-linking has the effect of changing a plastic from thermoplastic to thermosetting".

Thus, Whittington's Dictionary of Plastics teaches that curing is used in conjunction with thermosetting plastics and Hawley's Condensed Chemical Dictionary teaches that cross-linking changes a plastic from thermoplastic to thermosetting. If a "suitable curative" is used to "crosslink" the glycidyl azide polymer, a person skilled in the art would assume, based on the definitions of "cure" and "cross-link", that a thermosetting material is formed, not a thermoplastic material. Therefore, there is nothing in Zeigler that teaches or suggests that the glycidyl azide polymer cross-linked by the multifunctional isocyanate forms a thermoplastic elastomer.

Additionally, Zeigler does not teach using an aromatic diisocyanate and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2, 4-pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

Manzara et al. teach a hydroxyl terminated poly(glycidyl azide) with a hydroxyl functionality of up to 4 or more. Manzara et al. further teach that when using GAP as a binder for a solid rocket propellant GAP can be mixed with a polyisocyanate curing agent.

Manzara et al. do not teach that the glycidyl azide polymers can be formed into thermoplastic elastomers.

Manzara et al. teach that the glycidyl azide polymer can be combined with a polyisocyanate curing agent and heated to a cure temperature until a solid, elastomeric polyurethane matrix is formed (column 16, 4-13). There is no suggestion in Manzara et al. that this polyurethane matrix is a thermoplastic elastomer.

Manzara et al. also teach that glycidyl azide polymers converted to polyurethanes have good mechanical properties over the temperature range of -50°C to 120°C but can be advantageously be decomposed at temperatures below 130°C-150°C. (Col. 16, lines 46-48). Decomposition of a glycidyl azide polyurethane at temperatures below 130°C-150°C indicates that the polyurethane is not a thermoplastic. Thermoplastics do not decompose at temperatures below 130°C-150°C, but instead

generally melt. Thus, there is nothing in Manzara et al. that discloses or suggests a thermoplastic elastomer that is a polyurethane.

Additionally, there is nothing in Manzara et al. that discloses or suggests that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

Manser teach that block polymers such as THF and BDO can be formed with functionalities ranging from 0 to 4 (column 6, lines 35-47). Manser further teaches that if a difunctional polymer is copolymerized with a monomer, such as a diisocyanate, a linear copolymer will result and that if a trifunctional polymer is copolymerized with a diisocyanate, a cross-linked polymer will result. (Column 6, lines 49-67). Manser teach difunctional and trifunctional polymers can be mixed to control with exactitude the cross-linking density.

Manser does not teach that block polymers such as THF and BDO can be copolymerized with a monomer such as a diisocyanate to form a thermoplastic elastomer. Manser, as noted above, teaches controlling the cross-linking density of the polymer. A cross-linked polymer would not be a thermoplastic elastomer because the cross-linking would inhibit thermoplastic behavior.

Additionally, as discussed with regard to Manzara et al., there is nothing that discloses or suggests that the amount of aromatic diisocyanate, and hydroxyl terminated glycidyl azide

polymer used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

Ochoa Gomez et al. teach a method of synthesizing a glycidyl azide polymer with a hydroxyl functionality of two or more from polyepichlorohydrin.

Ochoa Gomez et al. do not teach reacting the GAP polymer with an aromatic isocyanate to form a thermoplastic elastomer or controlling the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and secondary diol so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

Thus, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not teach thermoplastic elastomer which is a polyurethane formed from hydroxyl terminated glycidyl azide polymer, an aromatic diisocyanate, and optionally 2,4 pentanediol. Moreover, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not teach controlling the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 20 is patentable over Zeigler in view Manzara et al., Manser, and Ochoa Gomez et al., and allowance of Claim 20 is respectfully requested.

Claim 22 depends from claim 20 and further recites that the aromatic diisocyanate is 4,4'-methylene bis-phenylisocyanate.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 22 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 22.

Claim 24 depends from claim 20 and further recites that the hydroxyl terminated glycidyl azide polymer has a molecular weight from about 25,000 g/mole to about 35,000 g/mole and a hydroxyl functionality of 2.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Moreover, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not teach a glycidyl azide polymer that has a molecular weight

from about 25,000 g/mole to about 35,000 g/mole and a hydroxyl functionality of 2. Therefore, claim 24 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 24.

Claim 25 depends from claim 20 and further recites that the inorganic salt oxidizer is selected from the group consisting of alkali metal nitrates, alkaline earth metal nitrate, alkali metal perchlorates, alkaline earth metal perchlorates, ammonium perchlorate, and ammonium nitrate.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 25 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 25.

Claim 26 depends from claim 20 and further recites that the inorganic salt oxidizer is phase stabilized ammonium nitrate.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic

diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 26 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 26.

Claim 27 depends from claim 20 and recites that the gas generating material further comprises a supplemental fuel.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 27 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 27.

Claim 28 depends from claim 27 and further recites that the supplemental fuel is cyclotrimethylenetrinitramine.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic

diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 28 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 28.

Claim 29 depends from claim 20 and further recites that the components of the gas generating material are present in a weight ratio adjusted to produce upon combustion a reaction gas product that consists essentially of carbon dioxide, nitrogen, and water.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 29 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 29.

Claim 30 depends from claim 20 and further recites that the polyurethane is formed from an aromatic diisocyanate, a

linear energetic polymer with a hydroxyl functionality of two or less, and 2,4 pentanediol.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Moreover, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a polyurethane is formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and 2,4 pentanediol. Therefore, claim 30 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 30.

Claim 35 recites an apparatus comprising an inflatable vehicle occupant protection device and a gas generating material that, when ignited produces gas to inflate the inflatable vehicle occupant protection device. The gas generating material comprises about 65% to about 90%, by weight of the gas generating material, an inorganic oxidizer salt and about 5% to about 35%, by weight of the gas generating material a thermoplastic elastomer. The thermoplastic elastomer comprises a polyurethane formed from

4,4'-methylene bis-phenylisocyanate, hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and optionally 2,4 pentanediol. The amount 4,4'-methylene bis-phenylisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to the hydroxyl groups used to form the polyurethane thermoplastic elastomer is about 1.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 35 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 35.

Claim 36 depends from claim 35 and further recites that the polyurethane is formed from formed from 4,4'-methylene bis-phenylisocyanate, hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and 2,4 pentanediol.

As discussed above with respect to claim 20, Zeigler in view of Manzara et al., Manser, and Ochoa Gomez et al. do not disclose or suggest a thermoplastic elastomer that consists

essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 36 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 36.

B. Obviousness rejection in view of Finck et al., Wardle, Biddle et al., and Menke et al.

Claims 20-37 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,525,171 to Finck et al., U.S. Patent No. 4,806,613 to Wardle, U.S. Patent No. 4,919,737 to Biddle et al., U.S. Patent No. 5,596,168 to Menke et al., and U.S. Patent No. 5,589,661 to Menke et al.

Claim 20 is patentable over Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661, because Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

As noted in the Office Action, Finck et al. teach that the compositions described in French application 9207067 consist of the product of the reaction of a glycidyl polyazide with a polyisocyanate as binder and of ammonium nitrate as oxidizing agent.

Finck et al. does not teach or suggest that the cross-linked glycidyl polyazide forms a thermoplastic elastomer. Finck et al. teaches that these compositions are difficult to process because they rely on crosslinkable binders which cure very quickly. A binder, which is cured by cross-linking, is generally not considered to be thermoplastic. To support the assertion that a binder, which is cured by cross-linking, is generally not considered to be a thermoplastic, the Applicant first refers to Whittington's Dictionary of Plastics.

Whittington's Dictionary of Plastics at page 59 and 60 defines the term "cured" as,

"To change the properties of a plastic or resin by chemical reaction, which for example may be condensation, polymerization, or addition; usually accomplished by the action of either heat or catalyst or both, and with or without pressure. The term cure is used almost exclusively in connection with thermosetting plastics, vulcanizable elastomers and rubbers."

Additionally, Hawley's Condensed Chemical Dictionary on page 325 defines cross-linking as the,

"Attachment of two chains of polymer molecules by bridges, composed of either, an element, a group, or a compound, which join certain carbon atoms of the chains by primary chemical bonds."

Hawley's Condensed Chemical Dictionary further notes that,

"cross-linking has the effect of changing a plastic from thermoplastic to thermosetting".

Thus, Whittington's Dictionary of Plastics teaches that curing is used in conjunction with thermosetting plastics and Hawley's Condensed Chemical Dictionary teaches that cross-linking changes a plastic from thermoplastic to thermosetting. If a "suitable curative" is used to "crosslink" the glycidyl azide polymer, a person skilled in the art would assume, based on the definitions of "cure" and "cross-link", that a thermosetting material is formed, not a thermoplastic material. Therefore, there is nothing in Finck et al. that teaches or suggests that the glycidyl polyazide cross-linked by a polyisocyanate forms a thermoplastic elastomer.

Additionally, Finck et al. do not teach using an aromatic diisocyanate and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

Wardle teach that two methods have been previously proposed for producing thermoplastic elastomers, which are derived from cyclic ethers. (Column 2, lines 25-29, lines 57-60). In one method, polymers may be joined together through a block linking technique in which an isocyanate linking moiety is used. (Column 2, lines 59-62).

Wardle, however, do not teach a thermoplastic elastomer that comprises a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4-pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

Biddle et al. teach (AB)_n thermoplastic elastomers can be formed with polyglycidyl azide as a soft block using a technique described in the Wardle patent. The technique described in the Wardle patent involves linking a hard block polymer with a soft block polymer using an isocyanate linkage. Wardle teaches that the isocyanate linkage can be formed from aromatic diisocyanates.

Biddle et al. in view of Wardle do not teach a thermoplastic elastomer that consists essentially of a polyurethane formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol. The thermoplastic elastomers in Biddle et al. and Wardle all require an additional polymer, which forms the hard block.

Further, Biddle et al. in view of Wardle do not teach that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4-pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is

about 1. As discussed above, both Biddle et al. and Wardle teach using an additional hard block polymer.

Menke '661 and Menke '168 teach a binder system for a propellant that can include isocyanate hardening difunctional or trifunctional, hydroxy-substituted glycidylazido polymers. Menke '661 and '168 do not teach that this binder system is a thermoplastic elastomer, that this binder system comprises formed from an aromatic diisocyanate and optionally 2,4-pentanediol, and that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4-pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

Thus, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4-pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 20 is patentable over Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 and allowance of Claim 20 is respectfully requested.

Claim 22 depends from claim 20 and further recites that the aromatic diisocyanate is 4,4'-methylene bis-phenylisocyanate.

As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 22 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 22.

Claim 24 depends from claim 20 and further recites that the hydroxyl terminated glycidyl azide polymer has a molecular weight from about 25,000 g/mole to about 35,000 g/mole and a hydroxyl functionality of 2.

As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Moreover, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not teach that the hydroxyl terminated glycidyl azide

polymer has a molecular weight from about 25,000 g/mole to about 35,000 g/mole and a hydroxyl functionality of 2. Therefore, claim 24 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 24.

Claim 25 depends from claim 20 and further recites that the inorganic salt oxidizer is selected from the group consisting of alkali metal nitrates, alkaline earth metal nitrate, alkali metal perchlorates, alkaline earth metal perchlorates, ammonium perchlorate, and ammonium nitrate.

As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 25 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 25.

Claim 26 depends from claim 20 and further recites that the inorganic salt oxidizer is phase stabilized ammonium nitrate.

As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic

diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 26 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 26.

Claim 27 depends from claim 20 and recites that the gas generating material further comprises a supplemental fuel.

As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 27 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 27.

Claim 28 depends from claim 27 and further recites that the supplemental fuel is cyclotrimethylenetrinitramine.

As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic

diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 28 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 28.

Claim 29 depends from claim 20 and further recites that the components of the gas generating material are present in a weight ratio adjusted to produce upon combustion a reaction gas product that consists essentially of carbon dioxide, nitrogen, and water.

As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 29 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 29.

Claim 30 depends from claim 20 and further recites that the polyurethane is formed from an aromatic diisocyanate,

hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and 2,4 pentanediol.

As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Moreover, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest a polyurethane is formed from an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and 2,4 pentanediol. Therefore, claim 30 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 30.

Claim 35 recites an apparatus comprising an inflatable vehicle occupant protection device and a gas generating material that, when ignited produces gas to inflate the inflatable vehicle occupant protection device. The gas generating material comprises about 65% to about 90%, by weight of the gas generating material, an inorganic oxidizer salt and about 5% to about 35%, by weight of the gas generating material a thermoplastic elastomer. The thermoplastic elastomer comprises a polyurethane formed from

4,4'-methylene bis-phenylisocyanate, a hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and optionally 2,4 pentanediol. The amount 4,4'-methylene bis-phenylisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to the hydroxyl groups used to form the polyurethane thermoplastic elastomer is about 1.

As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 35 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 35.

Claim 36 depends from claim 35 and further recites that the polyurethane is formed from 4,4'-methylene bis-phenylisocyanate, a hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and 2,4 pentanediol.

As discussed above with respect to claim 20, Finck et al. in view of Wardle, Biddle et al., Menke '168, and Menke '661 do not disclose or suggest (1) a thermoplastic elastomer that

consists essentially of a polyurethane of an aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and optionally 2,4-pentanediol and (2) that the amount of aromatic diisocyanate, hydroxyl terminated glycidyl azide polymer, and 2,4 pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1. Therefore, claim 36 is allowable for the same reasons as claim 20 and for the specific limitations recited in claim 36.

In view of the foregoing, it is respectfully submitted that the above-identified application is in condition of allowance, allowance of the above-identified application is respectfully requested.

Attached hereto is a marked-up version of the changes made to the specification by the current amendment. The attached page is captioned "Version with markings to show changes made."

Serial No. 09/553,137

Please charge any deficiency or credit any overpayment in
the fees for this amendment to our Deposit Account

No. 20-0090.

Respectfully submitted,

A handwritten signature in dark ink, appearing to read 'Richard A. Sutkus', written over a horizontal line.

Richard A. Sutkus

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The paragraph beginning at line 5, of page 3 was replaced with the following rewritten paragraph:

--The present invention is an apparatus comprising an inflatable vehicle occupant protection device and a gas generating material that, when ignited, produces gas to inflate the inflatable vehicle occupant protection device. The gas generating material comprises a polyurethane thermoplastic elastomer and an inorganic salt oxidizer. The polyurethane elastomeric material comprises a physically cross-linked linear copolymer of an aromatic diisocyanate and a linear energetic polymer having a hydroxyl functionality of two or less.--

IN THE CLAIMS:

Claim 20 was amended as follows:

20. (Twice amended) An apparatus comprising an inflatable vehicle occupant protection device and a gas generating material that, when ignited produces gas to inflate the inflatable vehicle occupant protection device, the gas generating material comprising:

an inorganic oxidizer salt; and

a thermoplastic elastomer, said thermoplastic elastomer ~~comprising~~ consisting essentially of a polyurethane formed from ~~an~~-aromatic diisocyanate, ~~a linear energetic polymer~~ hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and optionally 2,4-

pentanediol, wherein the amount of aromatic diisocyanate, ~~linear energetic polymer~~ hydroxyl terminated glycidyl azide polymer, and 2,4-pentanediol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

Claim 24 was amended as follows:

24. (Amended) The apparatus of claim ~~23~~ 20 wherein the hydroxyl terminated glycidyl azide polymer has a molecular weight from about 25,000 g/mole to about 35,000 g/mole and a hydroxyl functionality of 2.

Claim 30 was amended as follows:

30. (Amended) The apparatus of claim 20 wherein said polyurethane is formed from an aromatic diisocyanate, ~~a linear energetic polymer~~ hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and a secondary diol.

Claim 35 was amended as follows:

35. (Twice amended) An apparatus comprising an inflatable vehicle occupant protection device and a gas generating material that, when ignited produces gas to inflate the inflatable vehicle occupant protection device, the gas generating material comprising:

about 65% to about 90%, by weight of the gas generating material, an inorganic oxidizer salt; and'

about 5% to about 35%, by weight of the gas generating material a thermoplastic elastomer, said thermoplastic elastomer being a polyurethane formed from 4,4'-methylene bis-phenylisocyanate, a hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and optionally a secondary diol, wherein the amount of 4,4'-methylene bis-phenylisocyanate, hydroxyl terminated glycidyl azide polymer, and secondary diol used to form the polyurethane are controlled so that the ratio of isocyanate groups to hydroxyl groups used to form the polyurethane is about 1.

Claim 36 was amended as follows:

36. (Twice amended) The apparatus of claim 35 wherein the polyurethane is formed from formed from 4,4'-methylene bis-phenylisocyanate, a hydroxyl terminated glycidyl azide polymer with a hydroxyl functionality of two or less, and 2,4-pentanediol.